

# DIGITAL COMPLEMENTARY ASSETS

*Completed Research Paper*

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## Abstract

*Google, Facebook, Twitter, LinkedIn, etc. are some of the prominent large-scale digital service providers that are having tremendous impact on societies, corporations and individuals. However, despite the rapid uptake and their obvious influence on the behavior of individuals and the business models and networks of organizations, we still lack a deeper, theory-guided understanding of the related phenomenon. We use Teece's notion of complementary assets and extend it towards 'digital complementary assets' (DCA) in an attempt to provide such a theory-guided understanding of these digital services. Building on Teece's theory, we make three contributions. First, we offer a new conceptualization of digital complementary assets in the form of digital public goods and digital public assets. Second, we differentiate three models for how organizations can engage with such digital complementary assets. Third, user-base is found to be a critical factor when considering appropriability.*

**Keywords:** Complementary assets, digital public goods, modes of engagement, innovation

## Introduction

The exponential uptake and the extraordinary high number of users of large digital service providers such as Google search, Facebook, Twitter, YouTube or LinkedIn are without any doubt among the most remarkable recent developments in the field of Information Systems. Within less than a decade, these and other digital services have had a profound impact on the behavior of individuals, and operations of corporations, supply chains and entire societies. These digital services provide previously unseen capabilities based on network economics, ubiquitous accessibility and the unique provision of dedicated services (e.g., search, location, music, networking). As such, they have triggered entire new solution spaces and enabled countless product and process innovations around the globe. However, the exact role of these large service providers in the innovation ecosystem is still poorly understood and the academic IS community has so far struggled to provide a theory-guided, deeper understanding of the related phenomenon.

In his landmark paper (Teece 1986), David Teece explores the circumstances under which innovating firms actually harvest the economic gains of their innovation. He investigates ‘three fundamental building blocks’, the appropriability regime (nature of technology, legal mechanism of protection), the dominant design paradigm and the role of complementary assets and how innovators can engage with them. Our paper studies the role of complementary assets and regimes of appropriability in the current innovation ecosystem. In particular, we are interested to explore if large service providers such as Google, Twitter or Facebook can be seen as *digital complementary assets* facilitating innovations.

Thus, this research paper is aiming towards a better and more differentiated understanding of large digital service providers by utilizing Teece’s theory on complementary assets. In particular, we investigate the following two *research questions*:

- What are the characteristics of digital complementary assets?
- How do organizations engage with these digital complementary assets?

By answering these questions, we contribute to a theory-guided understanding of large digital service providers. We will be able to isolate such providers from the digital ecosystem. A theoretical grounding will help to explain phenomenon such as what are the differentiating characteristics of large service providers and how do they facilitate innovation? While at this stage, many of these service providers are solely discussed as instances (‘Facebook’, ‘Twitter’) or simply in terms of their actual capability (e.g., microblogging), we hope to provide an appropriate and theory-informed class for such digital assets. As such, we try to make them more accessible for Information Systems researchers.

This paper is structured as follows. In the next section we will provide a brief overview about the theoretical foundation of our work, i.e. Teece’s theory of complementary assets. Section 3 will introduce two types of digital complementary assets, i.e. digital public goods and digital public assets. We will describe the four characteristics of a digital public good and how these can become digital public assets when they reach a substantial number of users. Inspired by how Teece describes the way innovators engage with complementary assets, we will then discuss three modes for how to engage with digital public assets. The paper ends with a discussion covering our contributions to theory and practice followed by conclusions covering limitations of this paper and future work.

## Theoretical Foundation

Criticizing simplistic notions of competition, David J. Teece hypothesized how profits derived from innovation tend to be distributed over various stakeholders (Teece 1986). Teece’s framework identifies factors which determine who wins from innovation: the firm which is first to market, follower firms, or firms that have related capabilities that the innovator needs. The outcome is dependent on the configuration of three fundamental building blocks: the appropriability regime, the dominant design paradigm, and the nature and distribution of complementary assets.

The *appropriability regime* refers to environmental factors that govern an innovator’s ability to capture the profits generated by an innovation. Teece lists two factors as critical; (i) the degree of difficulty of imitating the core technology and (ii) the efficacy of legal mechanisms of protection (e.g., patents,

copyrights). The nature of technology may be thought of as the location along a spectrum ranging from highly accessible to highly inaccessible technology. The less accessible the technology, the better suited it is to appropriate private returns on innovation because imitation is more difficult, even without the benefit of efficient legal mechanisms of protection. This second aspect of appropriability varies across industries and from one technology to another. In some environments the appropriability regime is "tight" (technology is relatively easy to protect) and in others it is "weak" (technology is almost impossible to protect) (Teece 1986:287).

The *dominant design paradigm* refers to the evolutionary nature of product development (Anderson and Tushman 1990). In the early "pre-paradigmatic" stages of any industry development, product designs are fluid, manufacturing processes loosely and adaptively organized, and generalized tools and infrastructure used in the production. Competition amongst stakeholders manifests itself in competition amongst designs, which are markedly different from each other. After considerable trial and error in the marketplace, the most promising designs begin to merge. This evolved design is at some point able to meet a whole set of user needs in a relatively complete fashion, and this design becomes dominant. Innovation is not necessarily halted once the dominant design emerges, it could occur lower down in the design hierarchy, shaping the original innovation (Henderson and Clark 1990).

Finally, *complementary assets* are vital building blocks to the successful commercialization of an innovation. Of all of the parts of the framework, it is Teece's definition of complementary assets that has perhaps had the most prominent impact in literature. However, what actually constitutes a complementary asset is not entirely clear. Though there are examples given in his seminal 1986 paper, there are at the same time later papers that use 'capabilities' (a concept appropriated in the influential 1997 paper (Teece et al. 1997) interchangeably (Wade and Hulland 2004). In this paper, we adopt the view from the 1986 paper, that a complementary asset is a tangible good, IP property, and/or service, perceivable by customers, competitors, and partners alike. Teece (1986) argues that complementary assets take one of three relational forms: (a) "general purpose" assets which do not need to be tailored to a particular innovation, (b) specialized assets with unilateral dependence to the innovation, and (c) co-specialized assets with bilateral dependence. For instance, a startup innovator may lack the capability to manufacture or distribute its product, which leads to a business agreement with established firms that could provide such capabilities. Alternatively, complementary technologies might be necessary to realize value from the core innovation. This might or might not necessitate adaptation of the asset in question. Specialized complementary assets are generally acquired over long periods of time, path dependent, and specific to the context (Teece et al. 1997). Such resources are valuable and difficult to imitate and form a source of competitive advantage (Barney 1991).

In the current environment of low-capital intensive service innovation, reduced technological entry barriers and globalization of IT-based service production, a long tail of digital service providers has emerged (Anderson 2006). These services are offered over the web or dedicated service platforms (aws.com, AppStore, etc.) and form 'digital capabilities on the shelf' that have the potential to trigger, enable or enhance innovations. We will focus on better understanding the features of such *digital complementary assets*.

## Types of Digital Complementary Assets and their Characteristics

Digital complementary assets (DCAs) are the unit of analysis in this paper and belong to the category of *general purpose* assets (Teece 1986). As generic assets they are not tailored to the specific requirements of a corporate innovation. The service provided is uniform in its capability for all customers. This does not mean that customers cannot modify or configure this service (e.g., setting favorites, specifying advanced search queries), but this is not a service that is done by the DCA.

We only study *digital complementary assets*, i.e. the purpose of the asset is not a transformation of a physical item (e.g., manufacturing of shoes or computers). The latter have been the focus of Teece's research. Depending on the user base of the digital service, we differentiate two types of DCAs.

A *digital private good* (DPrG) is a DCA that provides a commercial, digital service as a solution to corporations. Such digital private goods are typically centered on the value proposition that they facilitate the transition of capital expenses into operational expenses. Based on the 'as a service' paradigm, providers of a digital private good follow a business model that is often based on generating revenues that

correlate with the usage volume. There are very limited network effects between the customers of a digital private good, i.e. the quality of the service provided does not correlate with the number of users of this service. The actual service consumption might require substantial user training as the service will often be a complex solution. Examples for digital private goods are Salesforce (CRM as a service), SAP's Business by Design (ERP as a service) and Amazon Web Services (aws.com) (infrastructure as a service). This type of DCA is widely studied (e.g., Riedl et al. 2010; Farhoomand 2007) and for the purpose of this paper out of scope.

Instead, we will focus our attention on *digital public goods (DPG)*. Unlike digital private goods, digital public goods are easily accessible, in most cases do not even charge for their use, the service consumption is intuitive and does not require any training and the more users the digital public good has, the higher will be the benefits to the user community. The primary aim of a digital public good is to provide services to the public as opposed to providers of digital private goods targeting corporations. However, the fact that some digital public goods were able to attract a very high number of users, in some instances exceeding 100 million (e.g., Facebook, Twitter, LinkedIn), made them also an attractive platform for corporations. Table 1 provides an overview about some of the most popular digital public goods and their services.

<b>Table 1: Popular DPGs and their services</b>	
<b><i>DPG</i></b>	<b><i>...as a Service</i></b>
Google, Yahoo, Bing	Search
Photobucket, Flickr, Picassa	Picture
YouTube, Hulu, Vevo	Video
Groupon, LivingSocial	Coupon
Facebook, MySpace, Orkut	Social Network
LinkedIn, Google+	Professional Network
Wikipedia, Hudong.com	Dictionary
iTunes/Ping, Spotify, Simfy	Music

## ***Digital Public Goods***

In the following we will study the specific characteristics of digital public goods as a specific subset of digital complementary assets. We derived these characteristics from the notion of a public good as it is used in economics, from the technology-acceptance model and from network theory. We will then discuss how they compare with the notion of complementary assets as introduced by Teece (1986). We like to stress that in the following we refer to end-users when we use the term 'customer' or 'consumer'.

### **Non-Excludability**

Digital public goods provide a digital service on standby and do have no substantial technical, price or contractual barriers to their consumption. As such, a DPG service can be regarded as *non-excludable*, i.e. every customer with Internet access can consume these services without any constraints.

First, DPGs do not have any significant *technical constraints* to exclude customers as they utilize the Internet as a medium of delivery and access to its digital services. They can be accessed as an ubiquitous capability from Internet-enabled devices including mobile solutions. As such, the technical access barrier can be regarded as very low and at least from a pure technical and ease of consumption viewpoint in first world countries practically as non-existent. Interventions by third parties that aim to control or restrict access are the exception (e.g., use of certain DPGs in China). In fact, the UN even declared Internet access as a human right in June 2011 (UN 2011), a declaration that provides an important foundation for the notion of a digital public good. There is virtually no setup required and consumption is purely consumer-driven.

Second, DPGs do not have any significant *price-based constraints* that would exclude users. The majority of DPGs can be consumed free of charge (e.g., Google search, Facebook, Twitter, LinkedIn). Any direct costs related to the consumption of a DPG are typical communication costs (e.g., Internet access, depreciation of required hardware), but there is in most cases no direct charge by the DPG. A few DPGs charge for the consumption of a single service (e.g., music as a service at iTunes/Ping). More common is a model that provides a free service consumption up to a certain threshold and then enforces charging in a stepwise function. For example, the pricing model of Dropbox is based on the Giga Bytes required by the user with the first two Giga Bytes currently being free of charge. Such “freemium” models (Anderson 2009) grant users a free basic package that can be augmented for a fee (e.g., the Yammer enterprise social network allows an organization to utilize its social network capability for free, but adds features such as account administration for a fee). The digital music service Spotify has a subscription model and collects its revenue either from advertisement or from consumers who are willing to pay for the removal of advertisements between the songs. Typically, the business model of the DPG is not dependent on direct customer revenue but on advertisement income and alternative forms of commercialization. As such, economic constraints do not exist for a large customer group.

Third, DPGs do not have any significant *contractual constraints* that would exclude end users. In particular, free of charge DPGs offer their services without any form of contractual arrangements that go beyond the acceptance of ‘terms and conditions’. The DPG provider does not select its customer and does not have to agree to the consumption. In fact, they simply do not know anything about the user before the user starts using their service. The DPG provides a ‘digital capability on stand-by’ and is ‘always on’. The customer is at least from a contractual viewpoint not locked in and can cease the service consumption at any point in time though there might be efforts involved in eliminating all data from the DPG’s platform. Due to the lack of any technical, price and contractual constraints, DPGs do not exclude consumers.

### Non-Rivalry

A DPG provides a service that is *non-rival*, i.e. consumers of the service do not compete with each other as the available resources are practically unlimited. For example, a consumer can download a digital picture from a DPG such as Flickr without any impact on any other user. He/she can setup a Facebook account without fearing that Facebook reaches a limit and he/she can watch a video on YouTube without wondering how many others are watching the same video right now. The breakdown of the web-based service provision due to an extreme peak in the web traffic (so called flash crowds, e.g., September 11) is the exception and a rare occurrence of competition between the consumers of the service. The enormous scalability of DPGs (e.g., Facebook users upload approx. 40 million pictures per day) is secured via large data centers (e.g., Facebook, Google) or complementary providers of digital private goods that offer cloud-based infrastructure as a service (e.g., aws.com). Due to the digital nature of the service provided and the scalability of DPGs there is no rivalry between consumers and their individual behavior does not have any constraining impact on the DCA availability for other customers.

The fact that a DPG is non-excludable and non-rival makes it comparable to a public good in economics. Paul Samuelson defined such public goods, or collective consumption goods, as goods “*which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtractions from any other individual's consumption of that good...*” (Samuelson, 1954).

As opposed to most, geographically constrained public goods (e.g., a lighthouse, a beach), DPGs are *global* public goods (Stiglitz 1999). As such, they can be compared to global public goods such as knowledge.

In some cases, a DPG is derived from the digitalization of private goods. A famous example is the Google Book Search initiative (books.google.com) and the attempt to provide unlimited access to previously constrained (rival) books.

### Versatility

There is a very long tail of DPGs (Anderson 2006). Only very few of these services reach a significant user base and become success stories like the ones listed in Table 1. In the firm belief that the well-tested technology-acceptance model (Davis 1989) also holds true in the world of DPGs, the users’ attitude towards DPG use, their behavioral intention to use DPGs, and ultimately their consumption of a DPG can be explained by their perception of usefulness and ease of use of a DPG. While the judgment of the

perceived usefulness of a digital service is out of scope for this paper, it is interesting to note that all large and successful DPGs are characterized by an obvious ease of use. A Google search is in its basic form an intuitive activity requiring populating one data entry field, and YouTube and Flickr provide the same simplicity in the search for videos or pictures. The wide uptake of these services across all types of users including all age brackets, nationalities, educational levels, levels of technological familiarity and other user characteristics, demonstrates the existing easiness in the consumption of these services. Ease of consumption could also be interpreted as no consumer is excluded based on lack of knowledge or skills. As such, it extends the non-exclusivity criteria above.

In order to achieve this ease of service consumption, DPGs follow the principles of service-oriented design in the way they offer their digital goods, i.e. abstraction, messaging and composability (Erl 2009). These three factors facilitate a high ease of consumption and new users of a DPG can typically start using the digital services on offer immediately.

First, a DPG provides a service without that the user has to comprehend the activities that are required to provide such a service. A user of Google search does not have to understand the search algorithm, a user of Twitter does not have to understand how messages are disseminated and the internal principles of microblogging (e.g. Twitter). A first-time user of YouTube can start watching and searching for videos immediately. This is the principle of *abstraction* and the core design principle behind the 'as a Service' model.

Second, a DPG has a very streamlined model of interacting with its user. Well-defined interaction points channel the behavior of the user and reduce the variety of consumption alternatives. This is especially the case for input and output data. A Google search user has exactly one data entry field in the basic search function. Twitter constraints the interaction via a field that allows a maximum of 140 characters. This is called *messaging*.

Third, a digital service facilitates ease of composition. Consumers of a DPG can without significant efforts create entire new emerging properties by bundling multiple digital services of alternative DPGs. For example, a so-called mash-up of Craigslist and Google Maps (housingmaps.com) allows locating vacant apartments on a city map. This is the principle of *composability*.

Such digital services are by nature easily appropriated, combined and recombined to form new meanings to social contexts. This lies at the heart of the Internet and current computing practice allows people unrelated to the original design and management activities to produce content in the form of new digital services. This phenomenon has been explored from multiple perspectives, e.g. from a market and regulatory view as generativity (Zittrain 2008), or from a software design perspective as SOA principles (Erl 2009) as discussed above. At the core lies the capability of humans to act on possible interactions with artifacts, whether these interaction patterns were originally anticipated by a designer or not. Essentially, an artifact affords possible interactions, some of which are more obvious than others. The *principle of affordance*, pioneered by J.J. Gibson (1977) is a central tenet of ecological psychologists. Affordance has been appropriated by HCI researchers as a means to understand interface design, and more recently by IS researchers to understand outcomes organizational adoption of information systems (Markus and Silver 2008). Affordances are seen as produced as a result of humans coexisting and attempting to interact with artifacts such as DPGs. In other words, what may constitute a meaningful affordance for one individual may stay unseen by another. In this sense, affordances are real, only insofar as there is one or more individuals that is capable to perceive them. This relational nature means that multiple affordances may coexist at multiple levels for multiple users concurrently (e.g., the airline KLM is using Twitter to listen to consumers while the Greater Manchester Police is using Twitter to send out messages in order to engage citizens in solving crimes). Some affordances may be explored by a growing group of people. Digital services use components to produce an intended effect. However, any digital service holds potential affordances not anticipated by the designer that come into effect as others are exposed to the service. A prominent feature of such affordances in the context of DPGs is that they are created only by relating multiple artifacts to form new compound services with new affordances.

### **Positive Network Effects**

The value proposition of a DPG relies heavily on the existence of positive network effects. Thus, the quality of the digital service correlates positively with the number of users of the digital service. This effect

is also known as positive externalities and demand-side economies of scale (Katz and Shapiro 1985). This has two reasons.

First, DPGs are based on the 'Prosumer' model (Toffler 1980), i.e. the service consumer contributes to the value proposition of the DPG by using it. This could be in the form of uploading digital artefacts (e.g., a picture on Flickr, a video to YouTube, a tweet to Twitter, a contact to LinkedIn, a bookmark to Delicious), by providing answers (e.g., a solution in Innocentive) or by providing annotations or judgements (e.g., the 'Like it' button in Facebook). The more users the DPG has, the more content will be on offer. This will increase the likelihood that the service consumer will find what he/she is looking for, or at least will stumble upon some useful content in the case of non-intentional use. Similar to the DPG provider who typically does not charge for its service, the consumer as a content provider does not charge for the provision of content. Thus, the elimination of fee-based constraints is bi-directional.

Second, user behaviour has impact on the perceived quality of the DPG offering. For example, popular videos on YouTube or pictures on Flickr will be ranked higher if they are watched by a higher number of DPG users. In this role, consumers of a DPG provide feedback in terms of crowd voting and contribute to the overall quality of the service provided.

### **Digital Public Assets**

The extraordinary growth in user numbers is one of the most astonishing features of the most popular DPGs. The combination of a new service that is perceived as being useful in combination with the previous factors, i.e. no customer is excluded for technical, economic or contractual reasons, customers do not compete with each other for limited resources and the digital service is easy to consume, has led to an in most cases exponential growth in the user base of these services. The increase in the user base then has further increased the quality (usefulness) of the service based on positive network effects triggering a further growth in numbers.

There is a very large number of DPGs, but only few have reached extraordinary numbers of active users. These types of DPGs have a very unique role in the class of digital complementary assets as their user numbers in terms of absolute figures, growth rates and also in proportion to their employee base is unique across all industries. The fact that some of these DCAs have more than 100 million users (e.g., Facebook, Twitter, LinkedIn) makes them a large virtual ecosystem in their own right. This large user base is a significant feature that complements the core service of the DPG (e.g., music, pictures).

We use the term *digital public assets* in order to reflect the special status of those DPGs that have reached a very high number of users. The value of a core innovation of most DPAs is much harder to get at through imitation since it is embedded in a very large number of users. Providers of a digital public asset then start to explore the opportunities that the existing large user network provides in its own right. A good example for this is the current attempt of Facebook to explore ways of commercializing its user base (e.g., via the commercial offer of video downloading services). In addition to the absolute number of users, DPAs also offer extreme scalability as a complementary asset to the innovator.

In summary, we can describe the following *development*. First, a digital service is developed that provides a well-defined and often narrow digital solution to end users (e.g., ability to upload pictures). Second, the service provider needs to ensure that (a) this digital service does not exclude any customer by providing the service either for free or a small fee only and with minimal contractual obligations, (b) the service delivery platform must be able to scale up so it does not become a resource bottleneck and consumers would start competing for this limited resource, (c) the service consumption needs to be intuitive and simple, and (d) the service needs to gain in value the more users consume this service. If the service provider successfully deploys these four design principles, we regard it as a digital public good. Being a digital public good is a necessary, but not sufficient criterion for becoming a widely used digital public asset. A number of factors (value of the service, brand awareness, competing solutions, viral effects) need to come together to ensure the transition from a digital public good to a digital public asset. While the end users will enjoy the even more compelling value of a digital public asset as compared to a digital public good, digital public assets are not only interesting for end users. Indeed, engaging a large (new) user base is potentially perceived as a critical affordance for many corporations. For this reason, we will from now on exclusively focus on digital public assets and differentiate in the next section three modes describing how corporations can engage with digital public assets.

## Modes of Engagement

Under the heading ‘denoted channel strategy issues’ Teece (1986) discusses alternative ways for an innovator to engage complementary assets in order to profit from the innovation. This conceptualization of assets encompasses a very wide variety of resources and includes hardware and facilities as well as patents and services. According to Teece, there are two extreme modes of channel strategies; integration or contract. An integration strategy implies that the complementary assets are either developed or purchased by the innovator who is striving for ownership. The contractual mode implies that the innovator accesses the complementary assets through contractual relationships.

In reality, these extremes are purely analytical as the vast majority of companies will never afford the upfront cost of developing all assets themselves, nor will most companies use contracted external parties for all assets required. Rather, most strive to find a balance in between these extremes integrating some assets, contracting others.

Both modes are consistent with the realm of digital services and DPAs. A DPA can choose to *internalize* an external innovation that it perceives as being of strategic importance. This can be done by acquiring the innovator (e.g., Google buying Motorola, eBay buying Skype) or by developing the same capability internally (e.g., Google+ building a social network solution, Microsoft developing a search engine).

In a similar way, contractual arrangements leading to *partnerships* are a popular way of connecting the innovator with the complementary asset. Examples are the joint efforts of Facebook and Delta to provide a complete process for passengers wanting to buy a ticket up to the provision of checking-in capabilities in Facebook.

However, unlike in the manufacturing-centered world of Teece, the space of digital services also has a third mode of engagement in addition to the partnership and the internalization, i.e. *consumption*. This is a substantial extension of Teece’s theory. Consumption as a mode of engagement is taking full benefit of the nature of a digital public good. Without any contractual-arrangement and simply reduced to accepting terms and conditions, the innovator, either the individual end-user or a corporation, consumes the digital complementary asset as a service. There is no modification of the DPA or any type of active engagement of the DPA.

In the following, we will elaborate on these three modes of engagement, i.e. consumption, partnership and internalization, in more detail.

### Consumption

The investments required in developing, providing and utilizing physical assets, made it unthinkable that such complementary assets could have been given away ‘for free’. Consequently, free consumption of a complementary asset was not existent in Teece’s theory. DPAs, however, provide their digital services often differently to the providers of complementary assets 25 years ago. The popular freemium model is an example of a business model in which a small subset of paying users subsidizes a very large set of consumers who can utilize the DPA’s services for free (e.g., Skype). Combined with the availability of open platforms, low development efforts, reliance on human capital and with often very narrow solutions in mind, a large set of digital public goods emerged that all could potentially act as digital complementary assets. As we have seen, a DPA is characterized by non-excludability, non-rivalry, versatility, positive network effects and a large user base. In effect, this means that a company can consume the DPA service offering, much like any end user would. *Individual consumption* describes the case that an end user benefits from a DPA for specific personal purposes (e.g., building an application for private purposes such as mapping own favorite places on a Google Map). This mode of engagement is fuelled by the Prosumer model and the increased capability of individuals to quickly build own innovations (see for example a large set of iPhone apps incl. features of Facebook). *Corporate consumption* captures the case of an organization that enriches its innovation with the capabilities of a DPA without that the DPA provider has to modify the digital service or the need for a formal contract (e.g., the inclusion of Facebook’s ‘Like it’ button or a Google Map). A simple acceptance of terms and conditions is enough for individual or corporate consumption to start. The DPA is not in the least adapted to the innovator, nor is there any significant service level agreement in place between the DPA and the innovator. Affordance is perceived by the innovator while the DPA has little or no awareness of the innovator. Consumption as a mode of



engagement implies low dependence of the DPA on the innovation whereas the innovation itself can vary in terms of its dependence on the DPA.

### **Partnership**

Unlike consumption, an engagement based on contractually secured partnerships is very much part of Teece's theory. Aligned with Teece, we also distinguish two types of partnerships in the domain of digital public assets. A core and very visible difference between consumption and partnership is that the DPA becomes an entry point to the innovation. For example, a provider of an innovative game might consume the services of Facebook in order to share scores among a network of friends. Users of this game would have to go to the web pages of the provider of the game to play it. In a partnership model, however, the DPA becomes an additional, potentially even the only entry point to this game, i.e. the users would play the game within Facebook. We distinguish two types of partnership, operational and strategic.

First, an *operational partnership* describes the case in which the DPA and the Innovator collaborate via a formal contractual engagement. This is, for example, the case when the innovator wants to launch an app on the platform of the DPA (e.g., Facebook). In this case, simple terms and conditions will not be sufficient. The innovation might be one of many comparable applications (e.g., for music, photos, locating cities) and there is no exclusivity for either the innovator or the DPA. Operational partnerships can be used by the innovator to boost the awareness for the innovation using the comprehensive user base and the capabilities of the DPA. An example is Animoto.com. Animoto is a web-based solution that produces videos by synchronizing selected music with photos and video clips provided by the user. Animoto launched their web site in August 2007. Widely unknown, Animoto launched a Facebook application in March 2008. This launch was highly successful with approx. 750,000 users signing up in three days and up to 25,000 in one single hour. This example shows that an organization with a highly innovative idea, i.e. how to combine music and pictures/video to an entire new, unique video utilizes a digital complementary asset such as Facebook to quickly access a large user base. Animoto is also engaging with YouTube and Facebook as delivery channels for the user-made videos. This documents that one of Teece's examples, distribution partners as an important complementary asset, is equally important in the world of digital services.

Second, a *strategic partnership* exists when a long-term collaboration is the objective aiming for potential exclusivity for one or both partners. This could mean, that the DPA is the only digital complementary asset used by the innovator or that the DPA is selecting the innovation as the exclusive provider of a certain capability on its platform. An example could be a DPA such as Facebook that elevates one of its many music apps to the status of the Facebook app for music. The strategic intent of such a partnership correlates significantly with the mutual dependence on each other, i.e. to what extent does the digital public asset provide an important feature for the innovation, and to what extent is the innovation an important capability within the service portfolio of the digital public asset?

### **Internalization**

Internalization in the area of digital public assets mostly means that the DPA internalizes the innovator as the enormous user base and market value of DPAs make an internalization of the DPA by the innovator often not an option. Internalization, like consumption and partnership, occurs in two forms.

*Internalization via acquisition* describes the case that the DPA buys the innovation or the entire company behind the innovation. This is motivated by a number of potential reasons including the aim to secure exclusive control over the innovation, to quickly benefit from the innovation, to catch up with competing DPAs in terms of the innovative capability, to get outstanding talent or to acquire related intellectual property (e.g., Facebook's acquisition of Friendster). Examples are Facebook's acquisition of Divvyshot, a photo management solution that became part of Facebook Photos, or the acquisition of Hot Potato, a social check-in service that became part of Facebook Places.

*Internalization via development* means that the DPA literally builds the innovation itself. This is typically the case, when the innovation is not protected and it is reasonable easy to develop the required capabilities. The higher the dependence of the DPA on the idea, the more the DPA will have a desire to gain control and either internalize the idea via acquisition or development.

Figure 1 summarizes the three modes of engagement including the two sub-types of each mode based on the mutual dependence between the innovation and the digital public asset. Unlike Teece's model (Teece 1986), we replaced the unilateral dependence of the innovation on the complementary asset with consumption as a new mode of engagement. The reasoning behind this is that an innovator has many opportunities to individually utilize a DPA without having the requirement to actually involve the provider of the DPA in this individualization, an opportunity that does not exist with physical complementary assets. Thus, the inclusion of consumption forms an important revision to Teece's model in the world of digital complementary assets.

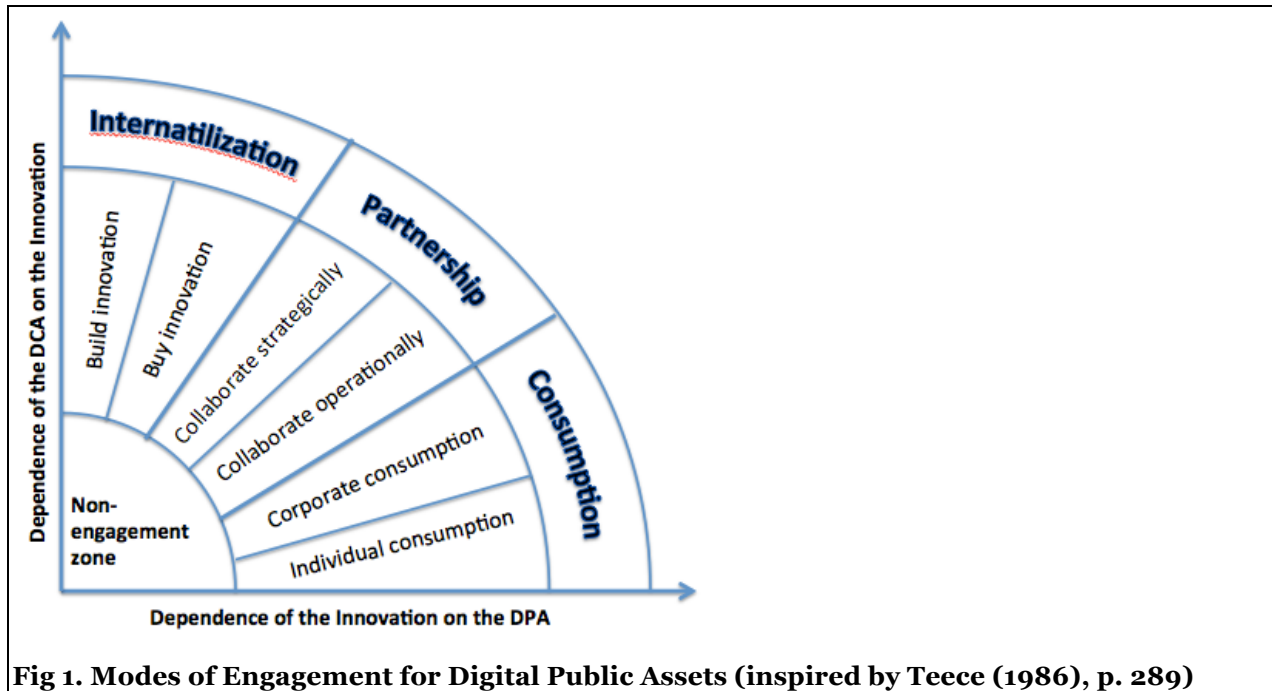


Fig 1. Modes of Engagement for Digital Public Assets (inspired by Teece (1986), p. 289)

### Engagement Modes as Process

The consumption mode has profound implications to the overall strategy of an innovator. On the one hand, initially when investment capacity is low, an innovator can still harness vastly powerful large scale services to augment the market offering in various ways. If successful, this could lead to a rapid acceleration of growth for the innovator. However, the low degree of formalization, initially an advantage, can then become a disadvantage. The innovator is highly dependent on the DPA to continue to provide the service while the DPA is far less dependent on the innovator. On the other hand, a DPA is generally wary of any developments in new digital services that could potentially detract from its user base if wielded by competition. Consequently, a DPA is constantly on the lookout for novel services to tie closely to the user base under its control.

This state of affairs can produce a situation in which the innovator needs a more formalized and dependable relationship with the DPA so as not to lose a vital asset, while the DPA needs to tie a promising new service to its own user base. This will lead to both parties entering a new mode of engagement. Most likely this will be some sort of contractual agreement, as described by Teece (1986). Once in a contractual arrangement, the innovator has a stable access to the DPA. In some cases, the DPA will start perceiving the innovation as critical enough to try to employ an internalization strategy. In this mode of engagement, a DPA will attempt to either buy the innovation or to build an imitation.

### Appropriability Regime

Apart from the core innovation at the heart of any successful business, there also exist surrounding conditions enabling the capture of the value of an innovation. As defined in Teece (1986), the appropriability regime concerns the ability of an innovator in an industry to protect the innovation either

through tight and effective control of intellectual property or through using technology that is very hard to imitate. The appropriability regime can thus be either tight (easily protected innovations) or loose (innovation is difficult to protect). This distinction is equally applicable to the realm of digital services. The nature of applicable appropriabilities highly influences the availability and desirability of different engagement modes in any given relation between an innovator and a DPA.

*“The most important dimensions of such a regime are the nature of the technology, and the efficacy of legal mechanisms of protection.”* (Teece, 1986, p. 287). Thus, we will discuss in the following two examples in which either legal mechanisms (music licences – Spotify) or the nature of the technology (Internet telephony – Skype) protect the innovation. Further examples (pictures – Flickr) will show what potentially can happen when the innovation cannot be protected, corresponding to Teece’s notion of weak appropriability.

### **Example 1: Facebook and Spotify – the Importance of Legal Mechanisms**

Spotify is a music streaming service offering some 15 million songs to 7 million users (about 800 000 paying) currently available in Sweden, Norway, Denmark, Finland, France, Spain, The Netherlands, the UK, and launching in the US. Customers can personalize their access by compiling favorite tracks into lists for later use. Launched in Sweden in 2007, Spotify was able to gain access to copyrighted content from major music labels. Artists and labels get paid a small amount of money each time a Spotify user plays one of their songs. Spotify is available as a limited free service with commercials, while paying premium customers get better bit rates, access to mobile device platform apps, and do not have to listen to commercials. Spotify chose a viral launch strategy. Users could give a limited number of friends an invitation to Spotify. In this way, growth in demand was matched with increase in capacity. Social media was an important enabler of this marketing strategy, but it was engaged in a non-specific way by users spreading the word. However, Spotify quickly realized the value of social media as a means of expanding their offering as well as increase their visibility and soon engaged a more active partnership with Facebook, allowing users to share playlists via their Facebook profiles. This development has greatly added to Spotify’s visibility. In 2011, there are signals (see e.g. Parr 2011) from Facebook that they are going to enter a new stage of social music and tie Spotify even more closely to Facebook by adding a permanent feature on the Facebook page. However, persistent rumors indicate that Facebook is considering a “Music Dashboard” that could host integrations with multiple streaming services, such as Pandora, Mog, Rdio, Last.fm, Grooveshark and more.

In this scenario, there are clear affordances attractive to both Facebook and Spotify. Facebook desires new ways of promoting Facebook use, while Spotify desires Facebook’s massive user base. However, the IP agreements with the major labels, at the core of Spotify, seem to prevent Facebook from employing a “build” strategy to compete directly with Spotify, thus resonating with Teece’s (1986) emphasis on legal protection as an important determinant of engagement mode. Consequently, Facebook and Spotify engage in a partnership. Interestingly, Facebook is considering becoming a social hub of music streaming itself. Multiple streaming services will be invited to compete for the Facebook user base. Users could then port their listening to Facebook regardless of which service they use. As a DPA, Facebook is looking to secure and expand its user base, this mode is more desirable than an exclusive partnership with just Spotify.

### **Example 2: Facebook and Skype – the Importance of Technology**

Skype offers voice communication over the Internet via their peer-to-peer based technology. Calls to other users within the Skype service are free, while calls to both traditional landline telephones and mobile phones use a debit-based account system. As of September 2011, Skype has 929 million registered users according to their service and in 2010 Skype accounted for 13% of the world total international calls.

In 2010, Skype released a version which integrated Facebook features. Facebook friends and their status updates were made visible in Skype. This made it possible to call or send SMS to Facebook friends from Skype. This partnership was swiftly intensified and in 2011 Facebook and Skype announced a strategic collaboration. Facebook users will now be able to use video communication utilizing Skype technology from within the familiar Facebook interface. Potentially, Skype could eventually offer its paid service

offering through Facebook, while Facebook could have a share of the revenue of such services. However, no announcements about actually going in that direction have yet been made.

In this case, both parties engaged in collaboration for mutual benefit, quickly moving towards a strategic partnership. By engaging in a strategic partnership, Facebook will not have to invest in internalizing the complex technology required for VOIP or videoconferencing to compete with the capabilities of the recently released Google+, whilst still offering its user base a similar experience.

The reason why Facebook has not opted to internalize Skype's core innovation, either by building or by buying, can be gleaned not necessarily from the user base (which is massive in both cases), but rather from the complexity of the technology involved in providing Internet telephony as a service. Indeed, as an indication of the value of Skype's innovation, Microsoft has recently acquired Skype for \$8.5 billion. Though size matters, this resonates strongly with Teece's (1986) assumption regarding the degree of difficulty involved in replicating complex technology influencing the choice of engagement mode.

### **Example 3: Facebook- Flickr – the Potential Lack of Protection**

Flickr was launched in 2004 as a photo-sharing service utilizing user-generated content. The original idea was based on a wave of consumer fascination with digital cameras. In 2005 Flickr was bought by Yahoo for 35 million dollars. In 2007, Facebook enabled users to share Flickr photos with friends directly through the Facebook profile (enabling consumption for Facebook users). This engagement (operational collaboration) from was from Facebook's point of view one of several (e.g. RockYou, Slide, Scrapblog, and Splashcast). In 2010 it was made possible for Flickr users to automatically share Flickr albums on Facebook.

In August 2011, Flickr announced that it had surpassed 6 billion photos (after 7,5 years of being a corporation). In comparison Facebook counted 10 billion uploads by October 2008 and surpassing 60 billion uploads in February 2011. That trajectory suggests that it will take Facebook two months to reach the amount of uploaded images it took Flickr 7,5 years to achieve. Yahoo seems to remain committed to pushing Flickr forward, but as its rivals are increasing their market share, the company may soon become a niche sharing website as Facebook combines their photo services into their core products.

Due to the fact that Facebook has an internalized photo service already, the integration between Flickr and Facebook becomes a way for Facebook to enable their users to access digital photos stored outside Facebook. The service provided by Flickr has been easy to imitate. Facebook launched its Facebook photo service in 2005 as a core part of their platform. There were no IP rights or technological know how that could prevent them. Since Facebook has its own photo service and there are several (photo) service providers engaging with Facebook, the position of Flickr is weak. Besides having a large user base, Facebook also has a capacity to scale up rapidly. Having a service to upload pictures is very different from getting access to music (requiring contracts with intellectual rights owners), or making VOIP-calls (requiring complex technology). Due to the fact that Facebook Photos exists, Flickr is likely less able to capitalize on their innovation. Indeed, the market share of Flickr is now dramatically decreasing.

## **Discussion**

This paper introduced the notion of digital complementary assets (DCAs) in an attempt to better understand the characteristics of the providers of large-scale digital services such as Google, Facebook or LinkedIn. The research has been motivated by the sharp contrast between the popularity, impact and growth rate of these services and the rather low level of theoretical investigation of this phenomenon. Interpreting these service delivery platforms as digital complementary assets makes them accessible for Teece's theory with a focus on complementary assets and the regimes of appropriability. Using Teece's theory as a sensitizing device in our study of such service providers combined with the notion of 'public goods' from macro-economics lead to the three modes of engagement. The findings of our research have implications for theory and practice covering the providers of a digital public asset as well as the innovators.

In terms of its academic impact, we make three *contributions to theory*. We propose the new conceptualization of a digital public good, add a third mode of engagement to Teece's theory of

complementary assets, and identify a new critical dimension of appropriability, i.e. a large user base, as a way to protect innovations.

First, we provided the notion of a '*digital public good*' as a way to conceptualize large digital services platforms in order to better understand this type of complementary assets. Perceiving Facebook, LinkedIn, Twitter etc. as a digital public good provides a first classification of such solutions based on the characteristics of non-excludability, non-rivalry, versatility, and positive network effects. The notion of digital public goods and these four characteristics make these service delivery platforms accessible to deeper theoretical explorations. A more thorough investigation into the macro-economic knowledge on public goods can be used in future research to gain an even deeper understanding. The nature of being a public good, however, also raises interesting questions related to governance and overall obligations in terms of accessibility to these services. Similar to widely known public goods such as public parks or transport infrastructure, digital public goods provide important infrastructure in the digital world. However, unlike most of the physical public goods, digital public goods are currently provided by private organizations. This fact can be explained by the lack of regional or statutory boundaries in the Internet and the user-driven design of Internet content. It also raises interesting questions with regards to government responsibilities in terms of these digital public goods (see for example Google in China or the fact that a German data protection authority declared Facebook's 'Like it' button as illegal).

Second, we added '*consumption*' as an entire new mode of engaging with a (digital) complementary asset. Motivated by the nature of being a public good, we added it as a third mode of engagement to Teece's theory. The available partnership and internalization were not able to explain the current phenomenon in which innovators can consume a digital public asset without formally engaging with its provider (e.g., via a contract). Consumption describes an engagement that capitalizes on the 'always on' nature of digital public assets. Facilitated by open access (non-excludability, non-rivalry) and versatility, innovators benefit from the business models of many digital public assets that give away their services for free to a large number of users in order to capitalize on advertisement revenue or revenue from users who are willing to pay for higher value adding services. As such, consumption can accelerate the development and dissemination of an innovation. Consumption provides the innovator with countless opportunities to embed services of a DPA into the innovation without the need to formally engage with the provider of the DPA. In particular, a DPA can provide a distribution channel as a complementary asset to the innovator and provide access to a large set of users that the innovator otherwise would not have.

Third, we deployed Teece's *regimes of appropriability* to digital public assets and demonstrated that we can explain the success, or failure to reap profits from innovation when engaging digital public assets. With a focus on those two regimes that Teece regards as being the most important, i.e. legal mechanisms and technology, we studied three documented cases. As we could show, his theory still holds true within digital service ecosystems. Providers of music such as Spotify are a prominent example for how IP rights allow protecting the innovation. Internet telephony is an example for how advanced technology helps to secure an innovation. However, we also demonstrated using the example of uploading pictures that a lack of IP rights and advanced technology can lead to a dominant role of a digital public asset and the potential disappearance of the innovator. Unlike in Teece's original theory, we now also include the fact that a DPA has a very large user base into the discussion. We regard a large user base as a critical dimension of appropriability. In addition to legal mechanisms and technology, an innovator can protect his/her innovation when it is embedded in and takes full benefit of a large, connected user base. However, as the number of innovators 'owning' large user bases is rather small, our theory may be able to explain why a few selected DPAs such as Facebook might become a center of gravity for a high number of digital innovations.

Informed by these theoretical contributions, we make the following *contributions to practice*.

First, we provide insights into the *design principles of digital public goods*. Little is currently known about how to engineer large digital service platforms. The four characteristics of a digital public good provide much needed design principles for organizations that like to engineer such services. As such, we help to better understand a very popular IT artifact in practice, i.e. large scale, service delivery platforms. This understanding can be used to derive development methodologies for each of the four characteristics, e.g. how to build-in positive network effects or how to ensure a versatile solution.

Second, we *provide a continuum of engagement modes* informing both sides the innovator and the DPA. This model helps innovators to better understand the spectrum of engagement alternatives on offer when they require the inclusion of the capabilities of a DPA. From a dynamic viewpoint, this spectrum of engagement modes can provide innovators with a potential strategic roadmap for how to appropriately engage with DPAs. For a provider of a DPA, we highlight options available when their dependence on the innovation is high.

Third, we highlight the *importance of a large user base* as a new, if not even as *the*, regime of appropriability. This can be seen as a warning sign to innovators who typically would lack such a large user base. If they cannot protect their innovation via either legal mechanisms or advanced technology, and the DPA sees high commercial value from the innovation, their access to a large user base that further amplifies the value of the innovation combined with the ability to build the innovation themselves, can mean that the innovator would miss out on the full benefits of the innovation. It is recommended to maximize efforts to legally protect the innovation or, where possible, to secure a community of users centered around the innovation and within the control of the innovator.

## Conclusion

Teece made a fundamental contribution to the understanding of the stakeholders that benefit from technological innovation (Teece 1986). 25 years ago the Internet did not exist and innovators relied on a number of complementary assets providing a variety of capabilities such as physical assets, technologies or brands. Nowadays, ubiquitous technologies, easy access to hardware and software, open platforms and an increased ease of use of digital services have enabled the emergence of a long tail of individual and corporate innovators. These innovators, like 25 years ago, still rely on complementary assets to capitalize on their innovations. However, an entire new type of providers of complementary assets has emerged. Harvesting the power of an increasingly networked and empowered, globalized user base, they provide specific digital services on scalable platforms leading in some cases to organizations with a user growth rate and a user base that has never been seen before in history.

This paper explored the opportunities to deploy and the need to revise or extend selected elements of Teece's theory for the new domain of digital innovations and digital complementary assets (DCAs). A differentiation of DCAs into digital private goods (DPrG), digital public goods (DPG) and digital public assets (DPA) provided a taxonomy allowing a separate investigation into the related phenomenon. A focus of this paper has been on the four characteristics of digital public goods (non-excludability, non-rivalry, versatility and positive network effects). Digital public assets are DPGs with a very large user base that in itself becomes an asset valued by innovators. Inspired by Teece's theory, we proposed three distinct modes of engagement between the innovator and the DPA. While Teece's concepts of partnership (operational or strategic) and internalization (build or buy) can be deployed to the domain of DPAs, it is the nature of a public good that motivated the extension of his theory with 'consumption' (individual or corporate) as a third and entirely new mode of engagement. Finally, we also reflected on the relevance of Teece's regimes of appropriability in the context of digital complementary assets and stressed the role of a large user base in terms of appropriability.

We see a number of directions for *potential future research* in this area. First, more research is required to increase the predictive quality of our theory. This would lead to models that are able to forecast with a higher level of confidence who will capture the value of an innovation in the world of digital complementary assets. Second, gathering new primary data will lead to deeper empirical insights. This could include in depth case studies of providers of digital public assets. Such a study could inform us about the perceived qualities of our theory and validate it in light of the strategic directions and business models of DPAs. In a similar way, a study could be conducted with corporations engaging with DPAs. Third, a longitudinal study of an innovator engaging with a DPA could be insightful in terms of gaining a better understanding of a process model for the proposed modes of engagements, i.e. what is a typical trajectory across the different modes of engagement? Fourth, we believe that more could be done on transferring insights from the economic theories of public goods to the domain of digital public goods. Fifth and finally, we see value in a deeper study of digital private goods from the viewpoint of digital complementary assets. At this stage, our research excludes digital private goods and it would be worthwhile to research the differences and similarities between digital private goods and digital public goods from the viewpoint of digital complementary assets, modes of engagement, and appropriability.

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